Update on ECal for GEp5

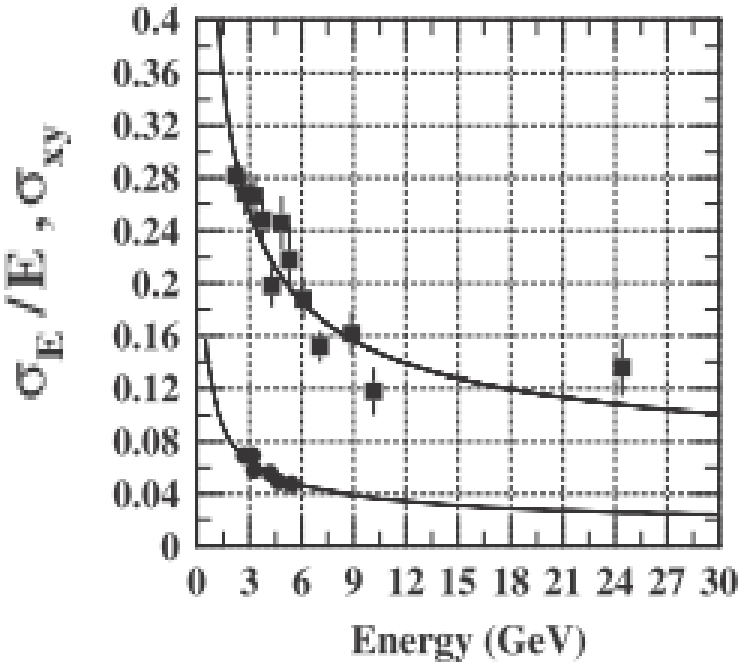
Mark Jones
Charles Perdrisat
Vina Punjabi
Ed Brash
Lubomir Pentchev
Carlos Ayerbe-Gayoso
Tony Losada

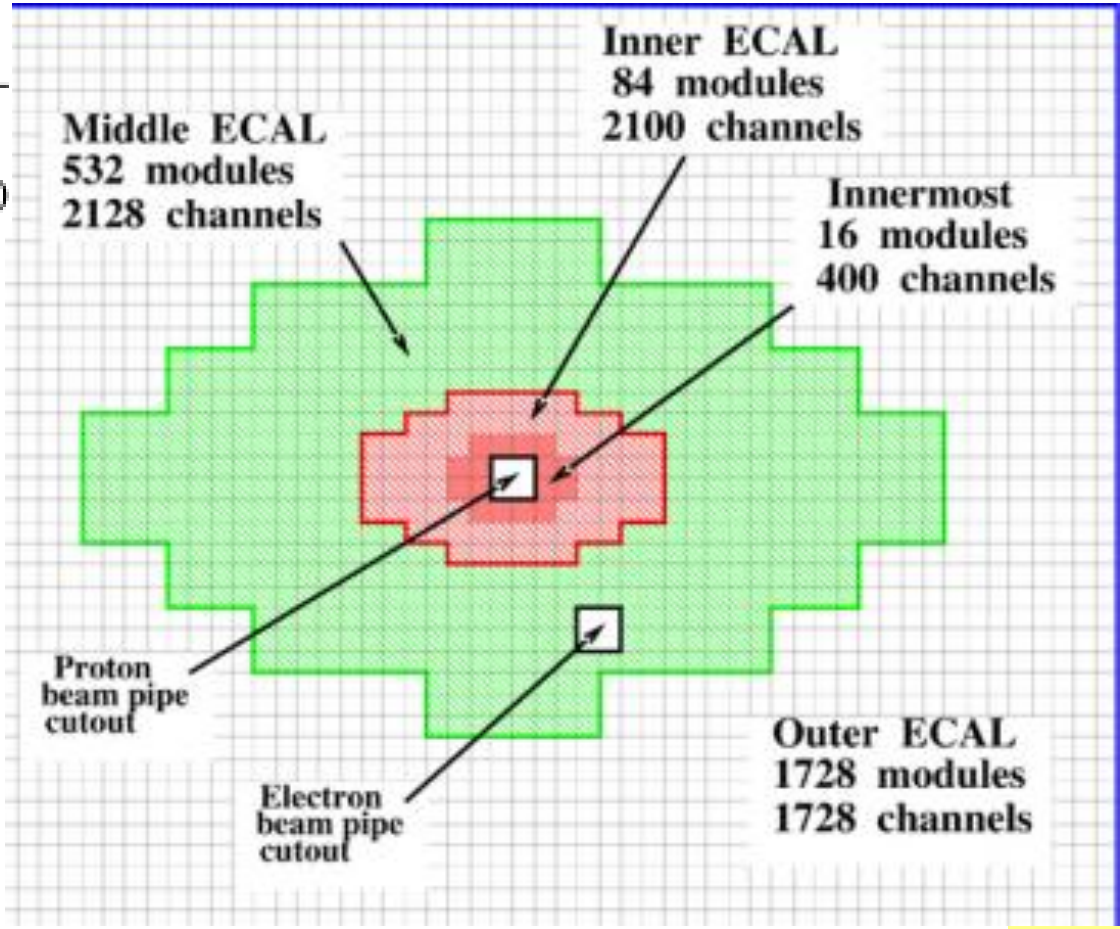
HERA-B Calorimeter

•Because of the radiation damage expect to the planned BigCal. Want to use a radiation hard electron " shashlyk" or sampling scintillator/absorber calorimeter like the HERA-B Ecal

• Large calorimeter. Looking into the MIDDLE or OUTER blocks

	OUTER
$\frac{\sigma_E}{E}$ (%)	$10.8(0.1)/\sqrt{E} \oplus 1.4(0.2)$
σ_{xy} (cm)	$2.17(0.09)/\sqrt{E} \oplus 0.28(0.15)$





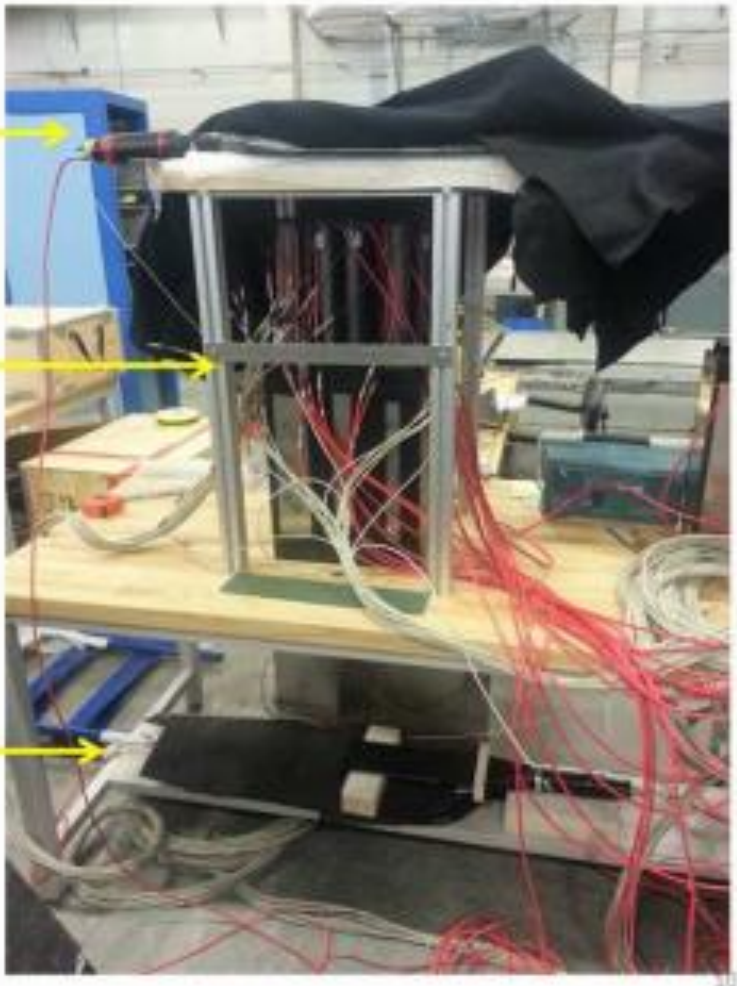
Test of HERA-B Calorimeter

•Started cosmic tests in February.

One scintillator 12''x6'' paddle on top

Arrangement of the modules

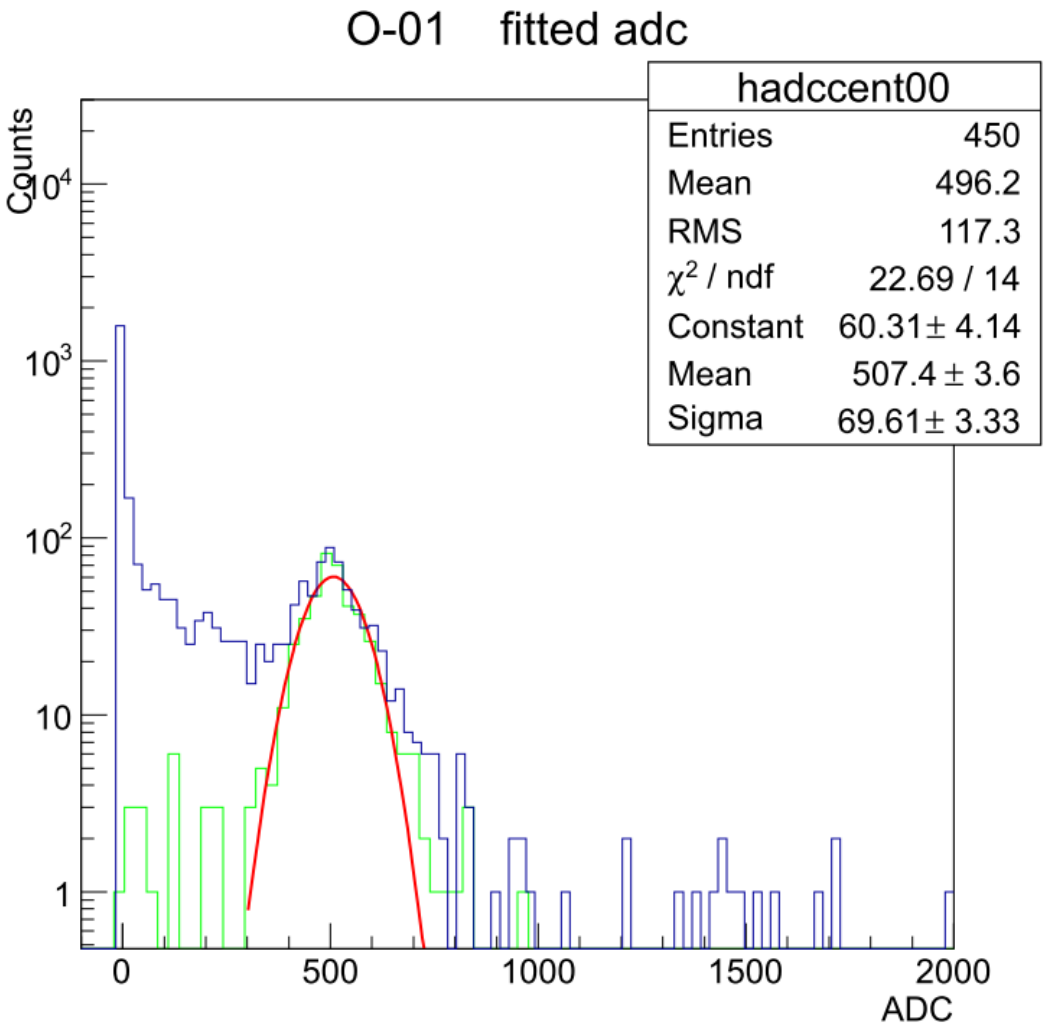
One scintillator 12''x6'' on bottom



4/25/2013

Test of HERA-B Calorimeter

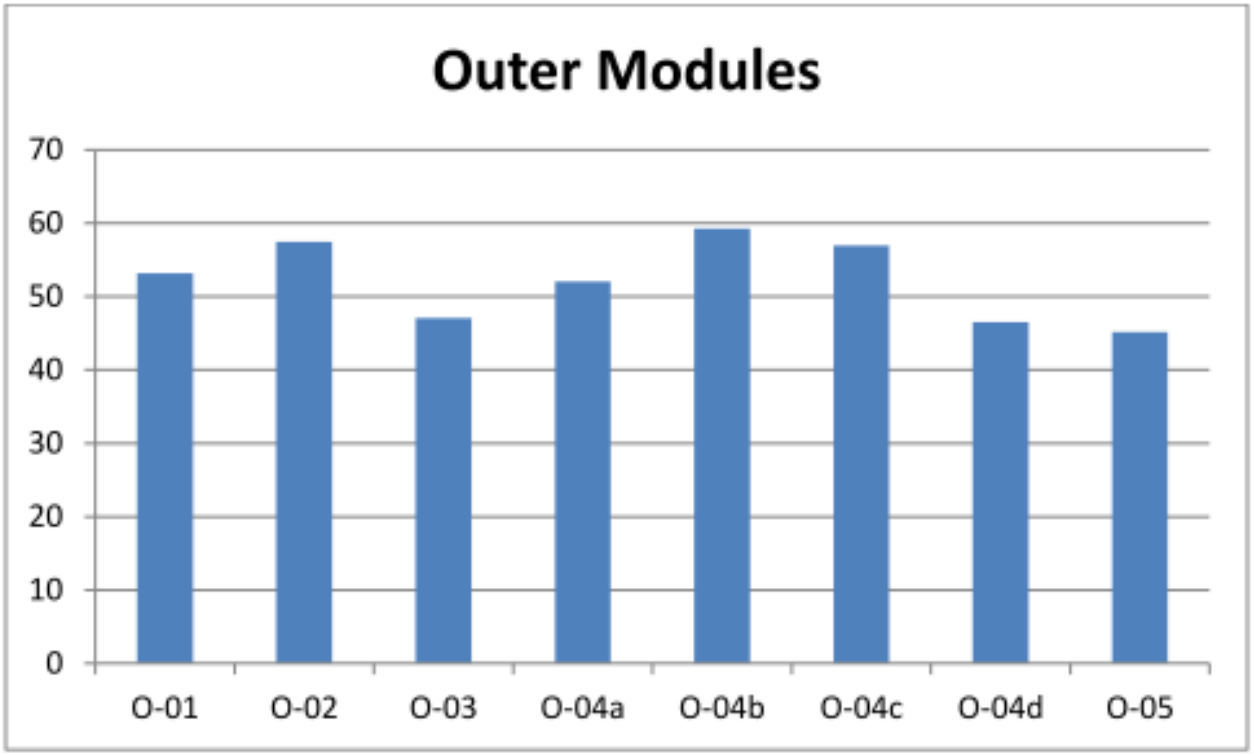
•Trigger on scintillators. Select event which as center block and no hits in surrounding blocks.



HERA-B Calorimeter Test

•Test of 5 “Outer” Modules (1 PMT for 11x11cm) give about 1000 photo-electrons per GeV which is consistent with the expected results.

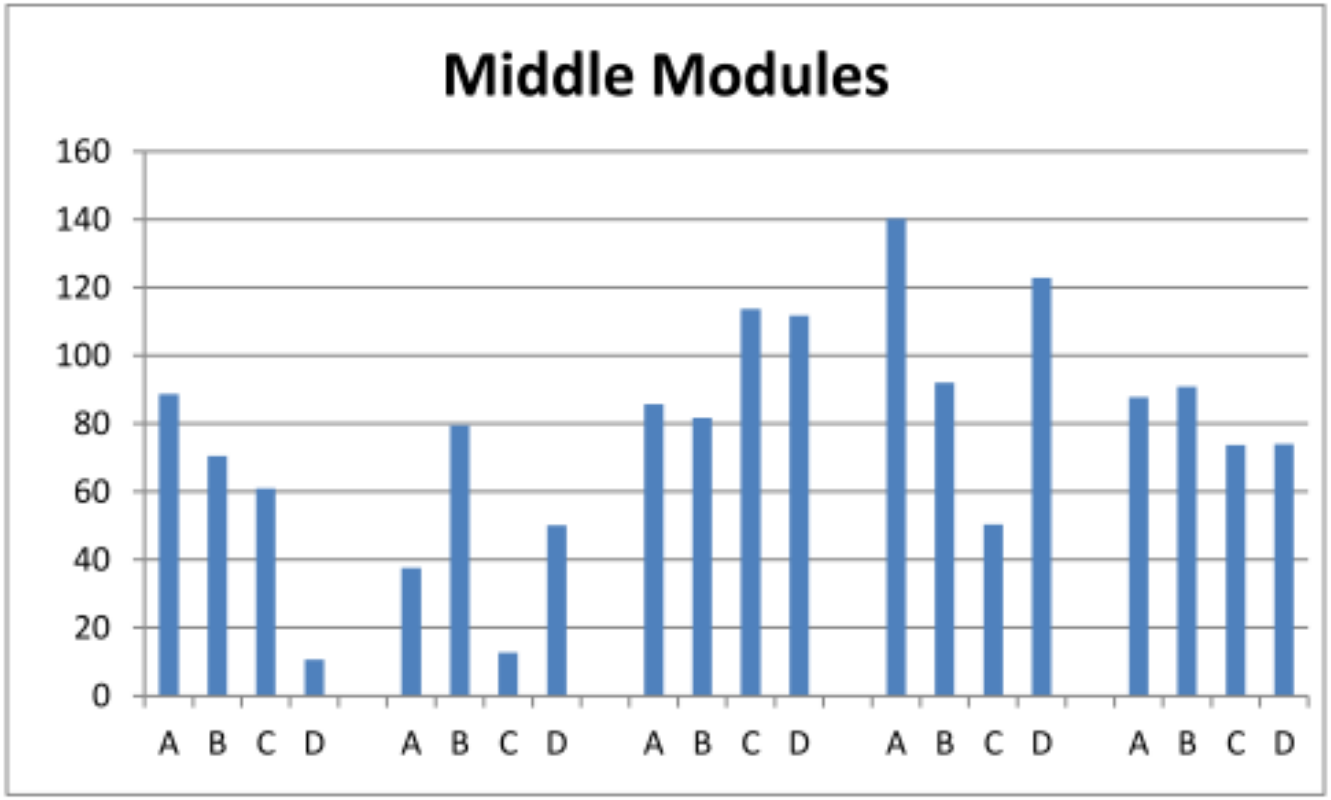
Number of photo-electrons
For 50 MeV
Energy deposit



HERA-B Calorimeter Test

•Test of 5 “Middle” Modules (4 PMTS divide 11x11cm) give more sporadic results.

Number of photo-electrons
For 50 MeV
Energy deposit

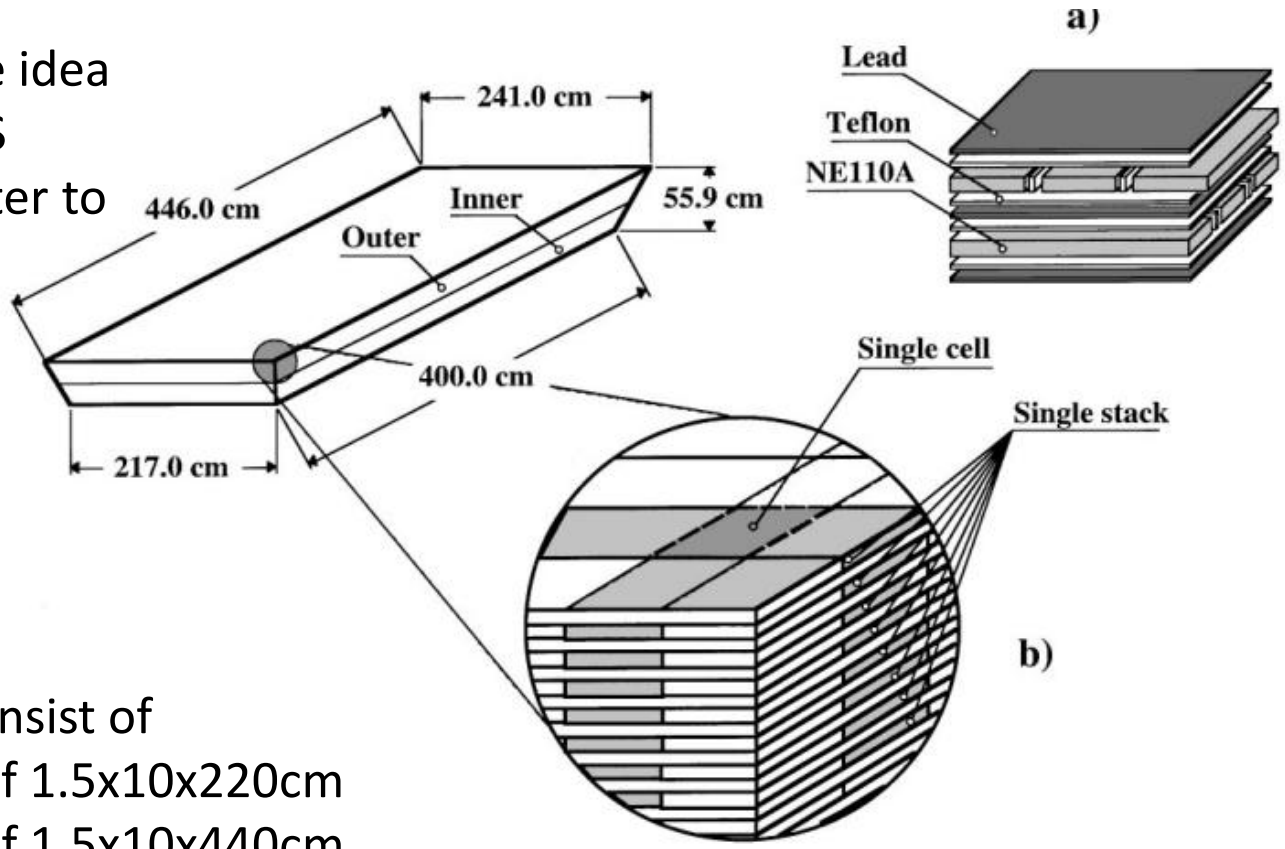


HERA-B Calorimeter Status

- Planning to test modules at SLAC with test beam in June. Secondary electron beam at 5Hz with beam energy between 3-15 GeV.
- But unfortunately at this point the likelihood of getting the modules is low. May get an answer by early 2014.
- Charles has asked for estimates of cost for new modules from other groups in Russia. The total cost range from $700K to $860K.

Using CLAS Large Angle Calorimeter

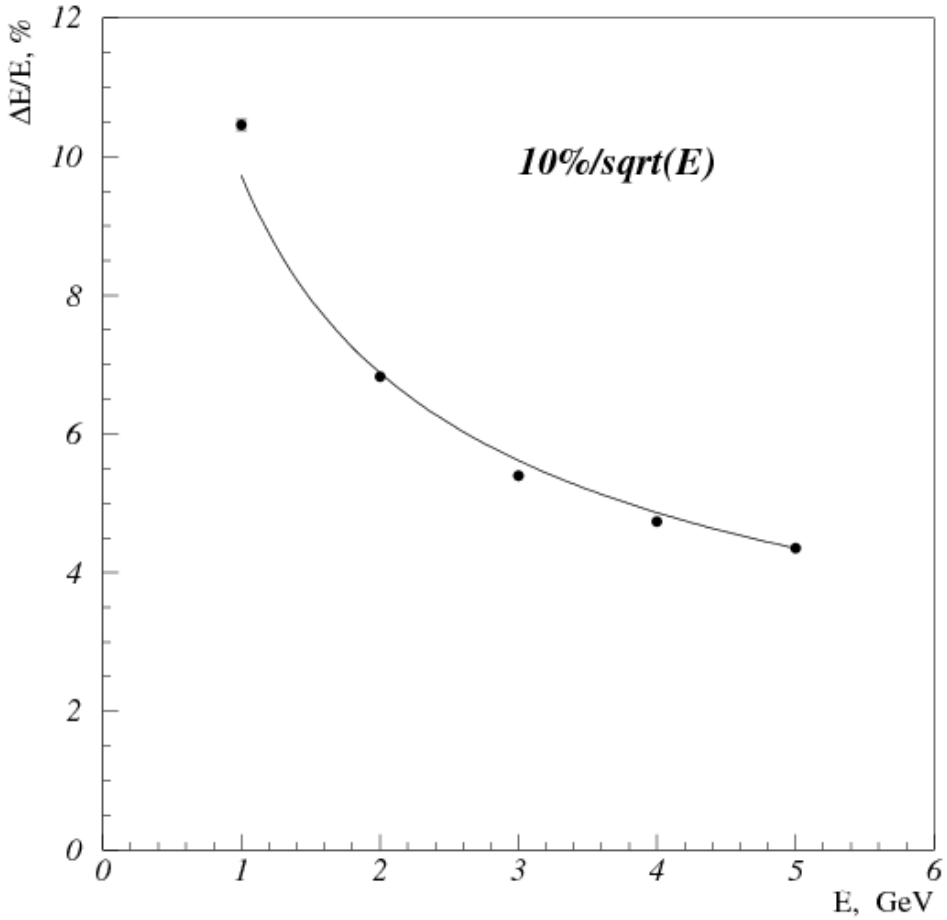
- Bogdan suggested the idea of cutting up the CLAS Large Angle Calorimeter to make sampling calorimeter.



- The scintillator is consist of
  - 40x17 planes of 1.5x10x220cm
  - 24x16 planes of 1.5x10x440cm.
- Lead is 0.2cm thick covering 220x440cm with 33 planes.
- Make a sampling calorimeter similar to the COMPASS HCAL with WLS panel along two sides.

Simulation of Energy Resolution

- Sampling calorimeter is 6x6cm2 with 30 layers of 0.22cm Pb and 1.5cm Scintillator.
- GEANT3 simulation of electron incident on center of sampling calorimeter with 1 radiation length of carbon in front.
- No accounting for the light collection inefficiency.



Calculation and figure by Lubomir Pentchev

Estimate of the cost

- Bogdan contacted Eljen to get a quote for cutting the scintillator and WLS fibers.
- $327K to cut scintillator into about 30,000 7x7cm tiles with edges diamond milled. Includes about 3000 new tiles.
- $72K for 2000 WLS with edges diamond milled.
- Cost for cutting lead, light guides, modules box and labor need to be estimated

Backup slides

HERA-B Calorimeter

•Want to use a radiation hard electron calorimeter like the HERA-B Ecal

• Large calorimeter. Looking into the MIDDLE or OUTER blocks

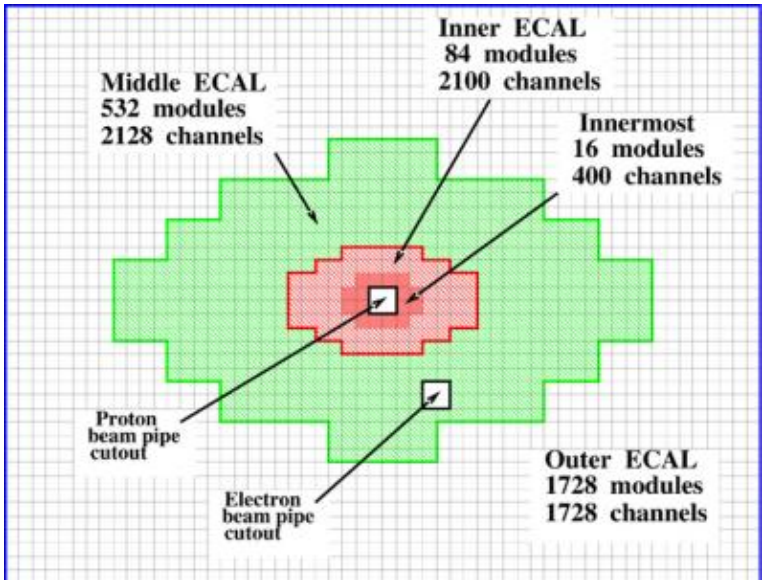


Table 1
HERA-B ECAL parameters

	INNERMOST/INNER	MIDDLE	OUTER
Channels	2100	2128	1728
Cell size	2.23 cm	5.59 cm	11.18 cm
Absorber	W–Ni–Fe alloy	lead (Pb)	lead (Pb)
Radiation length (X_0)	0.558 cm	1.675 cm	1.675 cm
Equiv. Molière rad.	1.24 cm	4.15 cm	4.15 cm
Depth	13 cm ($23X_0$)	34 cm ($20X_0$)	34 cm ($20X_0$)
Volume ratio	W:Sc = 2.2 : 1	Pb:Sc = 1 : 2	Pb:Sc = 1 : 2
WLS	Kuraray Y-11	BCF-91A	BCF-91A
Light yield (p.e./GeV)	130	800	1300
PM type	R-5600/FEU68	FEU-84-3	FEU-84-3
LED (wavelength, nm)	Marl (450)	L934SRCB (660)	L934SRCB (660)
Max. radiation dose (kGy/year) at shower-max	50/20	4	1

HERA-B ECAL MIDDLE module

MIDDLE module with one PMT of the four PMT shown

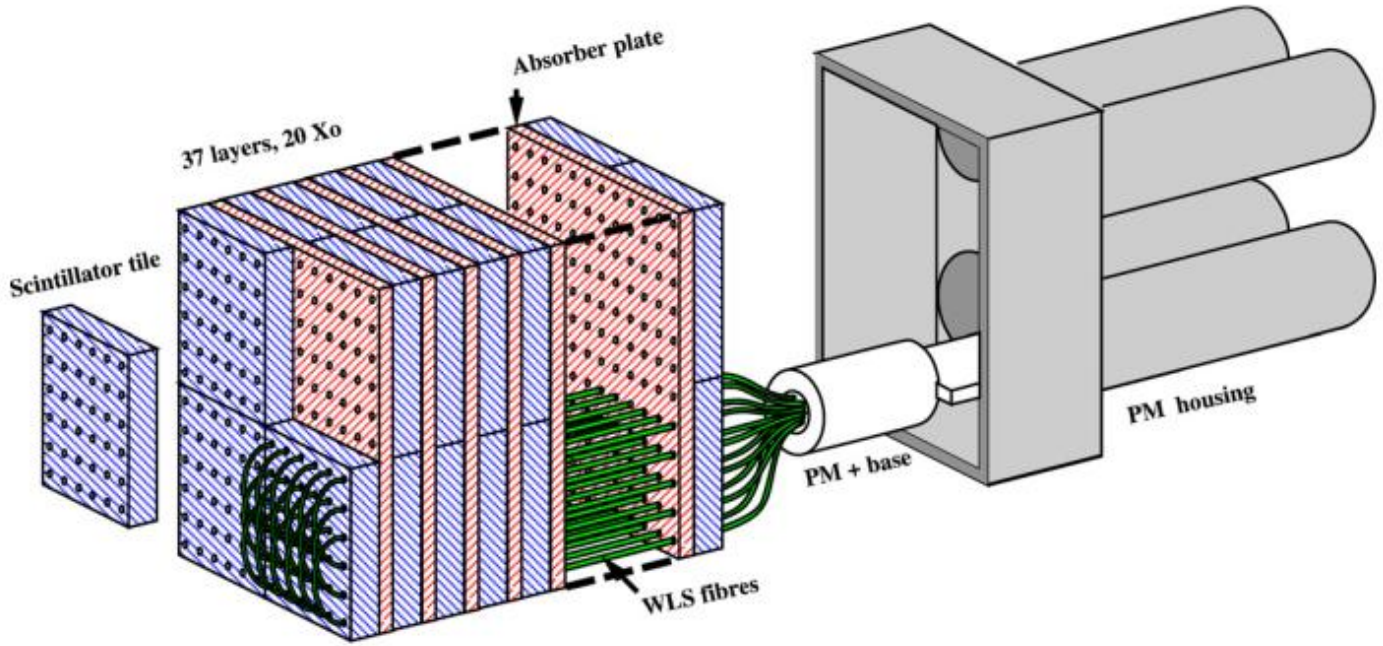


Fig. 4. MIDDLE ECAL module structure.

The OUTER ECAL module has the same transverse size but not segmented with only one PMT